Chukchi Sea Play 27: Early Sequence (Eocene)-Hope Basin

Correlative to Hope Basin Play 2

Geological Assessment

GRASP UAI: AAAAA DBB
Play Area: 4,230 square miles
Play Water Depth Range: 30-180 feet
Play Depth Range: 2,000-11,500 feet
Play Exploration Chance: 0.05376

Play 27, Early Sequence (Eocene)-Hope Basin, Chukchi Sea OCS Planning Area, 2006 Assessment, Undiscovered Technically-Recoverable Oil & Gas

Assessment Results as of November 2005

Resource Commodity (Units)	Resources *		
	F95	Mean	F05
BOE (Mmboe)	0	127	557
Total Gas (Tcfg)	0.000	0.593	2.555
Total Liquids (Mmbo)	0	22	102
Free Gas** (Tcfg)	0.000	0.584	2.511
Solution Gas (Tcfg)	0.000	0.009	0.044
Oil (Mmbo)	0	7	38
Condensate (Mmbc)	0	15	64

** Risked, Technically-Recoverable*

*** Free Gas Includes Gas Cap and Non-Associated Gas*

F95 = 95% chance that resources will equal or exceed the given quantity

F05 = 5% chance that resources will equal or exceed the given quantity

BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

Mmb = millions of barrels

Tcf = trillions of cubic feet

Table 1

Play 27, the "Early Sequence (Eocene)-Hope Basin" play, is the 21st-ranking play (of 29 plays) in the Chukchi Sea OCS Planning Area, with 0.4% (127 Mmboe) of the Planning Area energy endowment (29,041 Mmboe). The overall assessment results for play 27 are shown in table 1. Oil and gas-condensate liquids form 17% of the hydrocarbon energy endowment of play 27. Table 5 reports the detailed assessment results by commodity for play 27.

Table 3 summarizes the volumetric input data developed for the *GRASP* computer model of Chukchi Sea play 27. Table 4 reports the risk model used for play 27. The location of play 27 is shown in figure 1.

Play 27 consists mostly of Eocene(?) rocks. The Kotzebue basin wells penetrated rocks of Eocene age that are highly volcaniclastic and that have suffered extensive porosity destruction by diagenetic processes and compaction in reaction to deep burial. Therefore, the reservoir potential of the Early Sequence play is modeled as considerably lower than that of the Late Sequence play. We speculate that reservoirs consist primarily of fluvial-deltaic sands and conglomerates deposited along the edges of rift grabens formed during the early fault-driven phase of Hope basin subsidence in Eocene time. Organic matter in samples of the Early Sequence from the Kotzebue basin wells is cellulosic, with hydrogen indices generally below 200 mgHC/gTOC and total organic carbon values averaging <0.5%. The source potential of these rocks is therefore gas prone and very poor overall. The Early Sequence reaches thermal maturity in the central areas of both Hope and Kotzebue basins. Most of the Early Sequence sediments reached thermal maturity late in the deposition of the overlying Late Sequence (Pliocene and later), after most fault traps in both plays 26 and 27 had formed. Rocks correlative to play 27 were penetrated by the Cape Espenberg and Nimiuk Point wells in Kotzebue Sound.

Play 27, Early Sequence (Hope Basin), Chukchi Sea OCS Planning Area, 2006 Assessment, Conditional BOE Sizes of Ten Largest Pools			
Assessment Results as of November 2005			
Pool Rank	BOE Resources *		
	F95	Mean	F05
1	33	144	339
2	16	74	168
3	10	48	107
4	7	35	79
5	5	27	61
6	4.1	22	50
7	3.6	18	42
8	3.2	16	36
9	2.9	14	32
10	2.7	13	29

** Conditional, Technically-Recoverable, Millions of Barrels Energy-Equivalent (Mmboe), from "PSRK.out" file*

F95 = 95% chance that resources will equal or exceed the given quantity

F05 = 5% chance that resources will equal or exceed the given quantity

BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

Table 2

A maximum of 21 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 27. These 21 pools range in mean conditional (un-risked) recoverable volumes from 5 Mmboe (pool rank 21) to 144 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 33 Mmboe (F95) to 339 Mmboe (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 27.

In the computer simulation for play 27 a total of 21,465 “simulation pools” were sampled for size. These simulation pools can be grouped according to the USGS size class system in which sizes double with each successive class. Pool size class 11 contains the largest share (5,478, or 26%) of simulation pools (conditional, technically recoverable BOE resources) for play 27. Pool size class 11 ranges from 32 to 64 Mmboe. The largest 2 simulation pools for play 27 fall within pool size class 16, which ranges in size from 1,024 to 2,048 Mmboe. Table 6 reports statistics for the simulation pools developed in the *GRASP* model for play 27.

GRASP Play Data Form (Minerals Management Service-Alaska Regional Office)

Basin: Chukchi Sea Planning Area
Play Number: 27
Play UAI Number: AAAAA DBB

Assessor: K.W. Sherwood
Play Name: Early Sequence (Eocene) - Hope Basin

Date: January 2005

Play Area: mi² (million acres) 4,230 (2.707)
Reservoir Thermal Maturity: % Ro 0.25 - 1.02

Play Depth Range: feet 2,000 - 11,500 (mean = 8,000)
Expected Oil Gravity: ° API 40
Play Water Depth Range: feet 30 - 180 (mean = 165)

POOLS Module (Volumes of Pools, Acre-Feet)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Prospect Area (acres)-Model Input*	1620		3659		10530	14798/14610			30308				65960
Prospect Area (acres)-Model Output**	1639	2931	3815	6228	10735	14045/11156	18124	24036	29083	38319			65904
Fill Fraction (Fraction of Area Filled)	0.04	0.09	0.10	0.12	0.15	0.16/0.05	0.18	0.21	0.23	0.25			0.50
Productive Area of Pool (acres)***	100	392	524	883	1608	2211/1962	2845	3843	4687	6228	7300	8000	15832
Pay Thickness (feet)	30	66	73	89	110	116/37	136	152	165	185	210	229	360

* model fit to prospect area data in *BESTFIT*
** output from *@RISK* after aggregation with fill fraction
*** from *@RISK* aggregation of probability distributions for prospect area and fill fraction

MPRO Module (Numbers of Pools)

Input Play Level Chance	0.4
Output Play Level Chance*	0.3978

Prospect Level Chance	0.1344

Exploration Chance	0.05376

* First Occurrence of Non Zero Pools As Reported in PSUM Module

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
		Trap Integrity (highly faulted)	0.7
		Reservoir Presence (unknown)	0.8
		Chance Porosity > 10%	0.6
	0.5	Source Presence	
		Migration (mostly vertical up faults; risk of diversion to surface and no access for much of basin away from generation area)	0.4

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	26	29	31	34	39	39.94/7.46	43	47	49	52	57	60	78
Numbers of Pools in Play						2.15/3.03	4	6	7	8	10	11	21

Zero Pools at F39.80

Minimum Number of Pools	3 (F35)	Mean Number of Pools	2.15	Maximum Number of Pools	21

POOLS/PSRK/PSUM Modules (Play Resources)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Oil Recovery Factor (bbl/acre-foot)	34	85	106	152	223	244/122	312	366	406	472	530	600	1028
Gas Recovery Factor (Mcfg/acre-foot)	190	480	578	777	1056	1109/443	1376	1574	1711	1910	2100	2300	3369
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	650	965	1010	1090	1175	1173/147	1265	1315	1345	1400	1450	1480	1700
Condensate Yield ((bbl/Mmcfg)	13	18	19	22	25	25/5	28	30	31	33	36	38	50

Pool Size Distribution Statistics from *POOLS* (1,000 BOE): μ (mu)= 10.495 σ² (sigma squared)= 1.060

Random Number Generator Seed= 263367

BOE Conversion Factor (cf/bbl)	5620
Probability Any Pool is 100% Oil	0
Probability Any Pool is 100% Gas	0.9

Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	0.1
Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.5

Table 3. Input data for Chukchi Sea play 27, 2006 assessment.

Risk Analysis Form - 2006 National Assessment

Assessment Province:	Chukchi Sea OCS Planning Area	**Play Number, Name:**	27. Early Sequence (Eocene) - Hope Basin
Assessor(s):	K.W. Sherwood	**Play UAI:**	AAAAA DBB
Date:	1-Jan-05		

For each component, a *quantitative* probability of success (i.e., between zero and one, where zero indicates no confidence and one indicates absolute certainty) based on consideration of the *qualitative* assessment of **ALL** elements within the component was assigned. This is the assessment of the probability that the minimum geologic parameter assumptions have been met or exceeded.

			Play Chance Factors	Averge Conditional Prospect Chance[1]
1.	**Hydrocarbon Fill component** (1a * 1b * 1c)	**1**	***0.4000***	***0.4000***
	a. Presence of a Quality, Effective, Mature Source Rock			
	Probability of efficient source rock in terms of the existence of sufficient volume of mature source rock of adequate quality located in the drainage area of the reservoirs.	1a	0.40	1.00
	b. Effective Expulsion and Migration			
	Probability of effective expulsion and migration of hydrocarbons from the source rock to the reservoirs.	1b	1.00	0.40
	c. Preservation			
	Probability of effective retention of hydrocarbons in the prospects after accumulation.	1c	1.00	1.00
2.	**Reservoir component** (2a * 2b)	**2**	***1.0000***	***0.4800***
	a. Presence of reservoir facies			
	Probability of presence of reservoir facies with a minimum net thickness and net/gross ratio (as specified in the resource assessment).	2a	1.00	0.80
	b. Reservoir quality			
	Probability of effectiveness of the reservoir, with respect to minimum effective porosity, and permeability (as specified in the resource assessment).	2b	1.00	0.60
3.	**Trap component** (3a * 3b)	**3**	***1.0000***	***0.7000***
	a. Presence of trap			
	Probability of presence of the trap with a minimum rock volume (as specified in the resource assessment).	3a	1.00	1.00
	b. Effective seal mechanism			
	Probability of effective seal mechanism for the trap.	3b	1.00	0.70
	Overall Play Chance (Marginal Probability of hydrocarbons, MPhc)		***0.4000***	
	(1 * 2 * 3) *Product of All Subjective Play Chance Factors*			
	Average Conditional Prospect Chance[1]			***0.1344***
	(1 * 2 * 3) *Product of All Subjective Conditional Prospect Chance Factors*			
	[1] Assumes that the Play exists (where all play chance factors = 1.0)			
	Must be consistent with play chance and prospect distribution -- See discussion on Page 3 of Guide			
	Exploration Chance		***0.0538***	
	(Product of Overall Play Chance and Average Conditional Prospect Chance)			

Comments: *See guidance document for explanation of the Risk Analysis Form*

2b: Chance That Porosity >10%, Based on Regional Model for Porosity vs Reservoir Thermal Maturity

1a: 0.5 (Source Presence) X 0.8 (Maturation) = 0.40

Table 4. Risk model for Chukchi Sea play 27, 2006 assessment.

GRASP - Geologic and Economic Resource Assessment Model - PSUM Module Results

Minerals Management Service - Alaska OCS Region

GRASP Model Version: 8.29.2005)

Computes the Geologic Resource Potential of the Play

Play UAI:	**AAAAADBB**		**Play No.**		**27**		
World	Level	-	World	Level		Resources	
Country	Level	-	UNITED	STATES		OF	AMERICA
Region	Level	-	MMS	-		ALASKA	REGION
Basin	Level	-	**CHUKCHI**	**SEA**		**SHELF**	
Play	**Level**	**-**	**Play**		**27**	**Early Sequence (Eocene) - Hope Basin**	
Geologist	Kirk	W.	Sherwood			(Correlative to Hope Basin Play 02)	
Remarks	2005	Assessment					
Run Date & Time:		Date	19-Sep-05	Time		13:57:31	

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	127,470	206,380
Oil (Mbo)	7,332	27,181
Condensate (Mbc)	14,679	24,033
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	584,070	950,070
Solution Gas (Mmcfg)	8,612	32,673

10000 (Number of Trials in Sample)

0.3978 (MPhc [Probability] of First Occurrence of Non-Zero Resource)

Windowing Feature: used

Empirical Probability Distributions of the Products

Greater Than Percentage	BOE (Mboe)	Oil (Mbo)	Condensate (Mbc)	Free (Gas Cap & Nonassociated) Gas (Mmcfg)	Solution Gas (Mmcfg)
100	0	0	0	0	0
99.99	0	0	0	0	0
99	0	0	0	0	0
95	0	0	0	0	0
90	0	0	0	0	0
85	0	0	0	0	0
80	0	0	0	0	0
75	0	0	0	0	0
70	0	0	0	0	0
65	0	0	0	0	0
60	0	0	0	0	0
55	0	0	0	0	0
50	0	0	0	0	0
45	0	0	0	0	0
40	3,639	0	424	18,063	0
35	102,650	5,957	11,933	469,550	6,789
30	164,780	5,326	19,721	778,950	6,346
25	220,870	8,641	26,454	1,034,100	10,022
20	276,830	12,972	32,573	1,284,800	14,992
15	341,240	17,321	39,632	1,577,400	20,272
10	421,870	25,944	48,320	1,923,300	30,281
8	468,950	35,918	52,440	2,098,000	40,910
6	523,730	36,307	59,648	2,361,000	43,059
5	557,020	38,295	64,108	2,510,900	44,078
4	600,530	38,998	69,364	2,719,400	46,568
2	727,430	49,495	81,709	3,290,600	60,185
1	859,530	59,026	97,411	3,879,500	71,851
0.1	1,301,900	64,624	158,390	5,983,200	79,999
0.01	1,580,700	0	193,020	7,798,800	0
0.001	1,632,900	0	202,050	8,041,200	0

Table 5. Assessment results by commodity for Chukchi Sea play 27, 2006 assessment.

Basin: CHUKCHI SEA SHELF
Play 27 - Hope - Early Sequence (HB Play 2)
UAI Key: AAAAADBB

Model Simulation "Pools" Reported by "Fieldsize.out" *GRASP* Module

Classification and Size				Pool Count Statistics				Pool Types Count			Mixed Pool Range		Oil Pool Range		Gas Pool Range		Total Pool Range		Pool Resource Statistics (MMBOE)			
Class	Min (MMBOE)	Max (MMBOE)	Pool Count	Percentage	Trial Average	Trials w/Pool Avg		Mixed Pool	Oil Pool	Gas Pool	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Total Resource	Average Resource
1	0.0312	0.0625	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
2	0.0625	0.125	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
3	0.125	0.25	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
4	0.25	0.5	2	0.009317	0.0002	0.000503		0	0	2	0	0	0	0	1	1	1	1	0.336888	0.414474	0.751362	375.680953
5	0.5	1	18	0.083857	0.0018	0.004524		0	0	18	0	0	0	0	1	1	1	1	0.566116	0.994423	14.438780	802.154422
6	1	2	86	0.400652	0.0086	0.021613		6	0	80	1	1	0	0	1	2	1	2	1.011499	1.990858	133.178899	1.548592
7	2	4	352	1.639879	0.0352	0.088464		19	0	333	1	1	0	0	1	2	1	2	2.005231	3.998820	1085.743000	3.084497
8	4	8	1133	5.27836	0.1133	0.284745		95	0	1038	1	1	0	0	1	3	1	3	4.002466	7.996325	6914.275000	6.102626
9	8	16	2985	13.906359	0.2985	0.750188		255	0	2730	1	2	0	0	1	6	1	6	8.008182	15.992944	35965.153000	12.048627
10	16	32	4901	22.832518	0.4901	1.231717		473	0	4428	1	2	0	0	1	7	1	7	16.002118	31.994021	115374.859000	23.541084
11	32	64	5478	25.520615	0.5478	1.376728		580	0	4898	1	3	0	0	1	8	1	9	32.002160	63.975430	252561.321000	46.104660
12	64	128	4217	19.645935	0.4217	1.059814		457	0	3760	1	3	0	0	1	6	1	7	64.003720	127.997260	376545.685000	89.292313
13	128	256	1835	8.5488	0.1835	0.461171		237	0	1598	1	2	0	0	1	4	1	4	128.070962	255.879850	318584.078000	173.615295
14	256	512	416	1.938039	0.0416	0.104549		71	0	345	1	1	0	0	1	2	1	2	256.539407	509.886502	138334.294000	332.534363
15	512	1024	40	0.18635	0.004	0.010053		10	0	30	1	1	0	0	1	1	1	1	514.003277	935.319061	26681.706000	667.042664
16	1024	2048	2	0.009317	0.0002	0.000503		0	0	2	0	0	0	0	1	1	1	1	1032.534000	1477.601000	2510.135000	1.255068
17	2048	4096	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
18	4096	8192	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
19	8192	16384	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
20	16384	32768	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
21	32768	65536	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
22	65536	131072	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
23	131072	262144	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
24	262144	524288	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
25	524288	1048576	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0.000000	0.000000	0.000000	0.000000
Not Classified			0	0	0	0	Below Class	0	0	0									Below Class 0.000000	0.000000	0.000000	0.000000
		Totals	**21465**	**99.999992**	**2.1465**	**5.394572**	Above Class	0	0	0									Above Class 0.000000	0.000000	0.000000	0.000000

Number of Pools not Classified: 0
Number of Pools below Class 1: 0
Number of Trials with Pools: 3979

Min and Max refer to numbers of pools of the relevant size class that occur within any single trial in the simulation.

Min and Max refer to aggregate resources of the relevant size class that occur within any single trial in the simulation.

Table 6. Statistics for simulation pools created in computer sampling run for Chukchi Sea play 27, 2006 assessment.

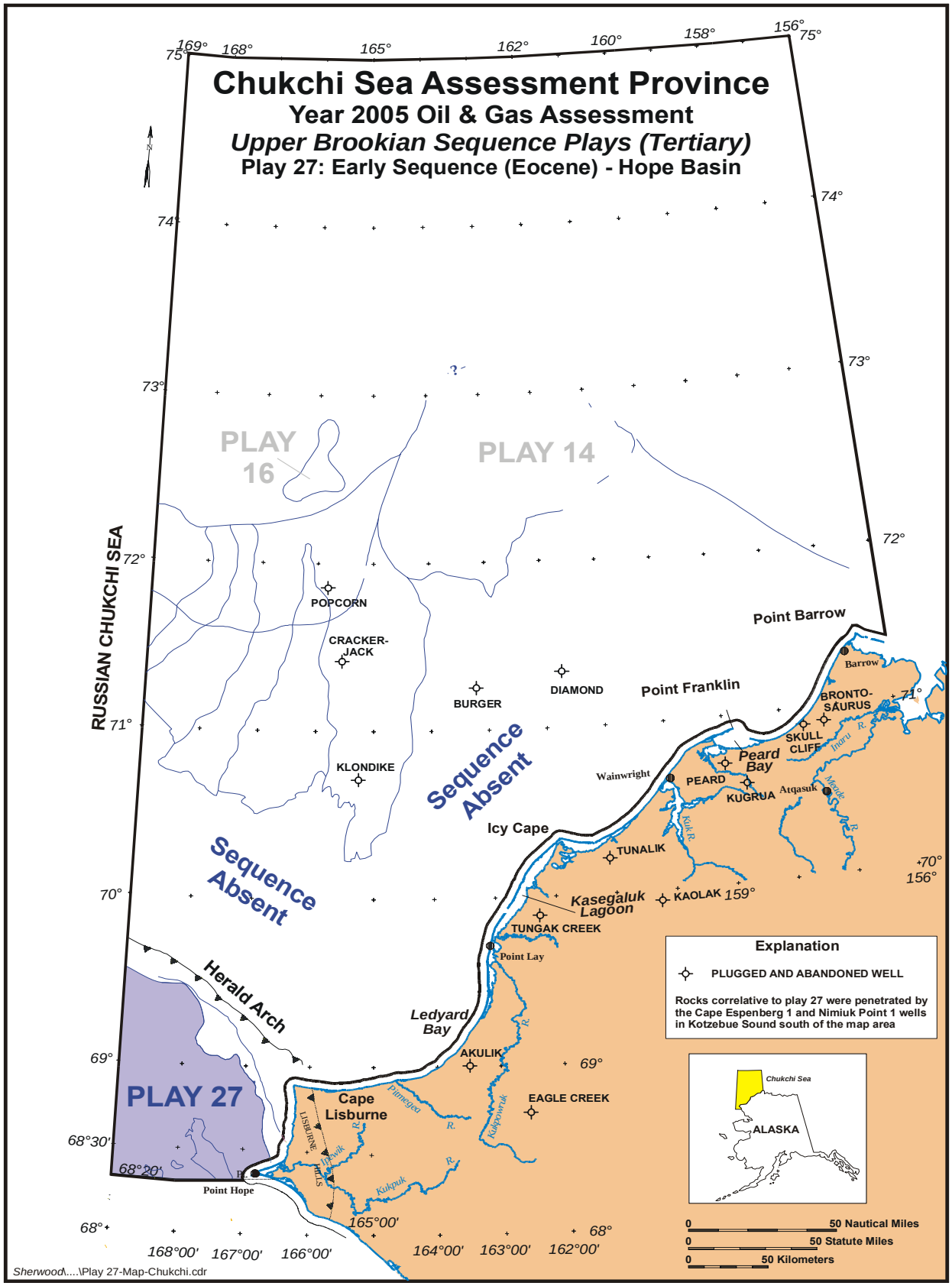

Figure 1. Map location of Chukchi Sea play 27, 2006 assessment.